

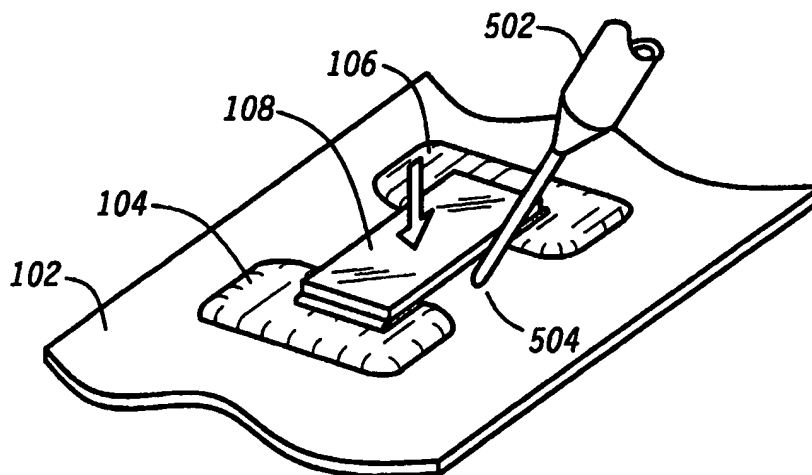


## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification <sup>7</sup> :</b> <b>C09J 5/00, G08B 13/14, H01L 23/52, B23P 19/00</b>	<b>A1</b>	<b>(11) International Publication Number:</b> <b>WO 00/52109</b> <b>(43) International Publication Date:</b> 8 September 2000 (08.09.00)
<b>(21) International Application Number:</b> PCT/US00/05522 <b>(22) International Filing Date:</b> 2 March 2000 (02.03.00) <b>(30) Priority Data:</b> 60/122,547                      2 March 1999 (02.03.99)                      US <b>(71) Applicant:</b> MOTOROLA INC. [US/US]; 1303 East Algonquin Road, Schaumburg, IL 60196 (US). <b>(72) Inventors:</b> EBERHARDT, Noel, H.; 21470 Krzich Place, Cupertino, CA 95014 (US). LOVING, Sean; 3056 Sam Juan Avenue, Santa Clara, CA 95054 (US). <b>(74) Agents:</b> FULLER, Andrew, S. et al.; Motorola Inc., Intellectual Property Dept., 8000 West Sunrise Boulevard, Fort Lauderdale, FL 33322 (US).		<b>(81) Designated States:</b> AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).  <b>Published</b> <i>With international search report.</i>

**(54) Title:** ELECTRONIC TAG ASSEMBLY AND METHOD THEREFOR**(57) Abstract**

An electronic tag assembly (100) includes a substrate (102) having an antenna pattern (104, 106) disposed thereon, an integrated circuit die (108) having electrical interface terminals (204, 206) that directly contact or interface with the antenna pattern (104, 106), and electrically non-conductive adhesive (202) interposed between the substrate and the integrated circuit die (108) that secures both together, and that maintains the integrity of the electrical interface. Preferably, a clamping force is exerted on the integrated circuit die (108) to maintain contact between the electrical terminals (204, 206) and the antenna pattern (104, 106) while the non-conductive adhesive (202) is being introduced.



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## **ELECTRONIC TAG ASSEMBLY AND METHOD THEREFOR**

### **Technical Field**

This invention relates in general to electronic assemblies, and in particular, to electronic tag assemblies that include the use of an integrated circuit part.

### **Background of Invention**

In electronic applications, there is often a need to form assemblies that include an integrated circuit part and a carrier substrate, with an electrical connection therebetween. Oftentimes, an electrical interface is established between the integrated circuit die and the carrier substrate, by soldering, wire bonding, electroplating, or by anisotropic conductive adhesive. Each of these prior art approaches has its own advantages and disadvantages including suitability for use with specific types of parts and manufacturing processes, assembly costs, and the like.

Anisotropic conductive adhesives have gained in popularity because of certain identified advantages in the manufacturing process. A typical anisotropic conductive adhesive contains metallic or other conductive particles which when compressed between electrical interfaces form a unidirectional electrical bond between the interfaces. Compression may be promoted by bumps or raised portions on one or more of the electrical interfaces. There are certain manufacturing difficulties involved when using conductive adhesives with small dimension parts. For example, the adhesive must be accurately applied so as to avoid short circuiting closely spaced terminals. Additionally, contact surfaces may need to be specially prepared to promote proper electrical connections. These and other costs disadvantages have limited the use of conductive adhesive for bonding integrated circuit dies to carrier substrates.

Electronic tag assemblies require a low-cost approach for attaching integrated circuit dies that is suitable for use in high-volume production. The integrated circuit die bonding approaches described in the prior art do not adequately address these needs. Therefore, an improved method for bonding an integrated circuit to form an

assembly, such as an electronic tag assembly is needed.

### **Brief Description of the Drawings**

FIG. 1 is a plan view of an electronic tag assembly, in accordance with the present invention.

FIG. 2 is a cross-sectional view of electronic tag assembly of FIG. 1.

FIG. 3 shows a substrate and an integrated circuit die in a pre-assembled stage, in accordance with the present invention.

FIG. 4 shows electrical interface terminals on the integrated circuit die in contact with an antenna in the form of a conductive pattern on the substrate, in accordance with the present invention.

FIG. 5 shows a non-conductive adhesive being introduced in between the integrated circuit die and the substrate, in accordance with the present invention.

FIG. 6 shows the integrated circuit assembly in which the adhesive maintains electrical contact between the electrical interface terminals of the integrated circuit die and the conductive pattern of the substrate, in accordance with the present invention.

### **Detailed Description of the Preferred Embodiment**

The present invention provides for an electronic tag assembly suitable for use in high-volume, low-cost applications in which an integrated circuit die is bonded to a substrate using non-conductive adhesive. The integrated circuit die is placed on the substrate such that electrical terminals thereon contact an antenna in the form of a conductive pattern on the substrate. While maintaining contact between the electrical terminals and the conductive pattern, a non-conductive adhesive is introduced in between the circuit die and the substrate, to secure the integrated circuit die to the substrate, and to maintain contact between the electrical conductors and the conductive pattern. Preferably, a clamping force is exerted on the integrated circuit die to maintain contact between the electrical terminals and the conductive pattern while the non-conductive adhesive is being introduced.

FIG. 1 shows a plan view and FIG. 2 shows a cross-sectional view of an electronic tag assembly 100, in accordance with the present invention. The electronic tag assembly 100 is an integrated circuit assembly that includes a chip-type part 108

having communication circuitry thereon, and an electrically coupled antenna 104, 106. The chip-type part 108 is a semiconductor die formed using a standard manufacturing process. Preferably, the die 108 has electrical interface terminals in the form of raised electrical conductors 204, 206 or bumps that function as electrical interface contacts.

In the preferred embodiment, the antenna 104, 106 is implemented on a substrate 102, preferably formed from fibrous material, such as paper or cloth, plastic, or other inexpensive material. The antenna 104, 106 is formed as a pattern of two spaced apart deposits of conductive material. Preferred conductive materials include carbon ink, carbon filled polymer, or other materials suitable for low cost applications. The conductive pattern may be printed, painted, or otherwise disposed on the substrate in a low cost manner. In the preferred embodiment, the conductive pattern and the electrical interface conductors are devoid of transitional elements.

The integrated circuit die 108 is adhesively affixed to the substrate 102 using an electrically non-conductive adhesive 202. The electrical interface contacts 204, 206 protrude from the integrated circuit die 108 and directly contact or interface with the conductive pattern 104, 106 on the substrate 102. The electrically non-conductive adhesive 202 is interposed between the integrated circuit die 108 and the substrate 102, and makes direct contact therewith. The adhesive 202 secures the integrated circuit die 108 to the substrate 102, and maintains electrical contact between the electrical conductors 204, 206 and the conductive pattern 104, 106.

FIGs. 3,4,5, and 6 show the electronic tag assembly 100 in various stages of construction, in accordance with the present invention. With reference to FIG. 3, the antenna or conductive pattern 104, 106 is printed on or otherwise disposed on the substrate, and the integrated circuit die 108 is separately prepared, such as by using a standard manufacturing process. With reference to FIG. 4, the integrated circuit die 108 and the substrate 102 are brought together such that contact is established between the electrical conductors 204, 206 on the die 108, and the conductive pattern 104, 106 on the substrate 102. A clamping force is applied to maintain contact between the electrical conductors 204, 206 and the conductive pattern 104, 106.

With reference to FIG. 5, while maintaining contact between the electrical conductors 204, 206 and conductive pattern 104, 106, and non-conductive adhesive is introduced in between the integrated circuit die 108 and the substrate 102. Preferably,

the integrated circuit die 108 is held in place by the clamping force, while an adhesive dispensing needle 502 is positioned in between the die 108 and the substrate 102, and an adhesive dispensed. The clamping force is maintained while the adhesive cures. When such clamping force is removed, contact between the electrical conductors 204, 206 and the conductive pattern 104, 106 is maintained by the adhesive 602, see FIG. 6.

The present invention provides for significant advantages over the prior art. An electronic tag assembly suitable for high-volume, low-cost applications is provided without the use of expensive anisotropic adhesives, and without the use of special materials and processes that add substantial expense or complexity. By establishing direct electrical contact between the integrated circuit die terminals and the antenna pattern, and by using an

electrically non-conductive adhesive to maintain such contact, an inexpensive manufacturing process is provided.

What is claimed is:

### Claims

1. A method of forming an integrated circuit assembly, comprising the steps of:  
bringing together an integrated circuit die, having electrical terminals thereon,  
and a substrate, having an antenna pattern thereon, such that contact is  
established between the electrical terminals and the antenna pattern;  
establishing direct contact between electrical terminals and the antenna  
pattern;  
introducing an electrically non-conductive adhesive in between the integrated  
circuit die and the substrate; and  
maintaining direct contact between the electrical terminals and the antenna  
pattern using the electrically non-conductive adhesive.
2. The method of claim 1, further comprising the step of printing the antenna  
pattern on the substrate.
3. The method of claim 2, wherein the step of printing comprises the step of  
printing a conductive pattern using carbon containing material.
4. The method of claim 3, wherein the step of printing comprises the step of  
printing the conductive pattern on paper.



5. A method of forming an electronic tag assembly, comprising in order the steps of:

- (a) placing an integrated circuit die on a substrate such that electrical conductors on the integrated circuit die contact an antenna pattern disposed on the substrate; and
- (b) while maintaining contact between the electrical conductors and the antenna pattern, introducing an adhesive in between the integrated circuit die and the substrate to secure the integrated circuit die to the substrate, and to secure contact between the electrical conductors and the antenna pattern.

6. The method of claim 5, wherein the adhesive consists of electrically non-conductive adhesive.

7. The method of claim 5, wherein step (b) comprises the step of disposing the adhesive to contact the integrated circuit die and the antenna pattern to form a bond therebetween.

8. The method of claim 5, wherein the substrate is formed from paper, and further comprising the step of printing the antenna pattern on the paper.

9. An electronic tag, comprising:

a substrate;

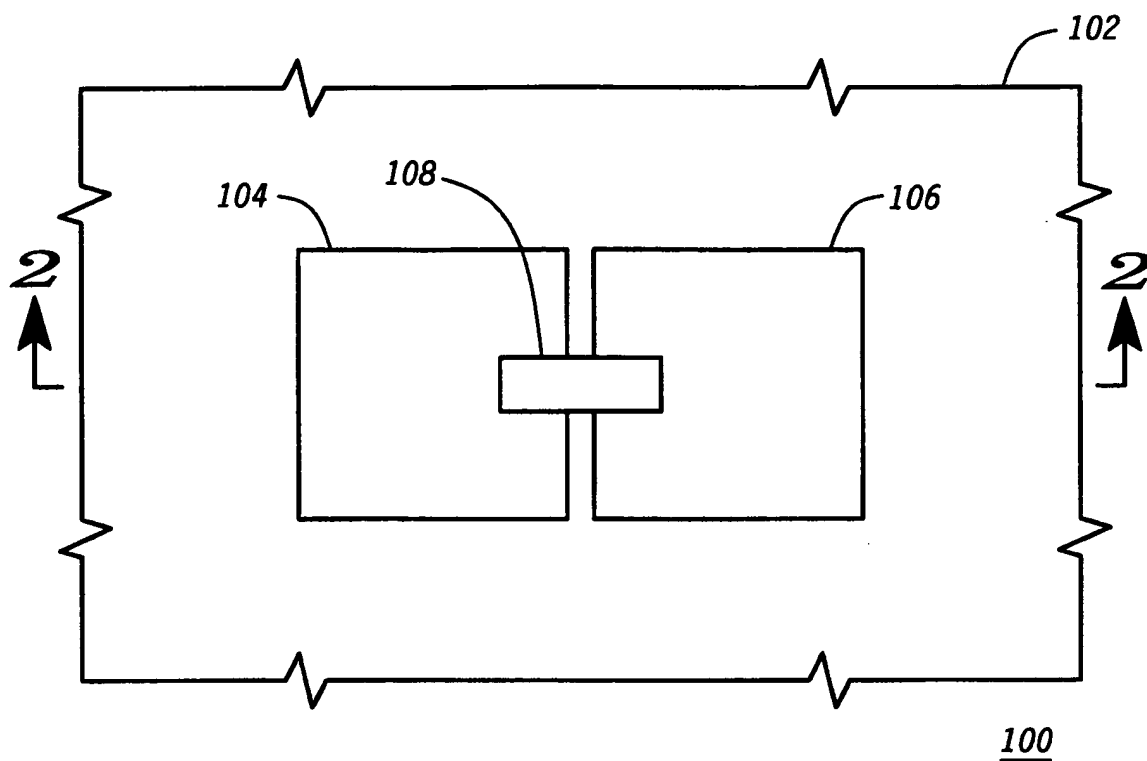
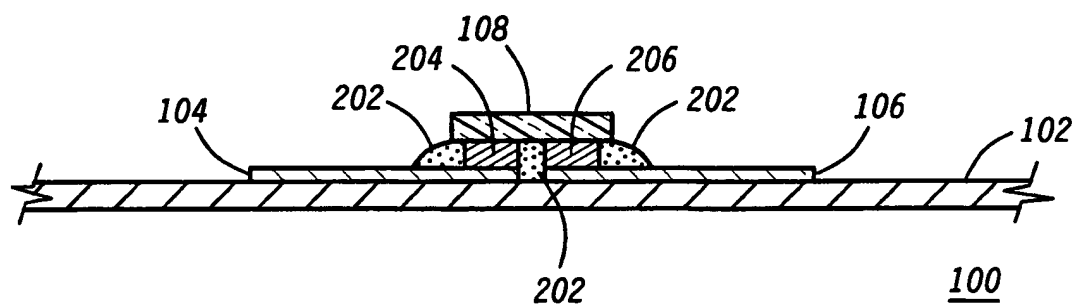
an antenna comprising first and second spaced apart conductive patterns  
formed on the substrate;

an integrated circuit die having first and second electrical interface conductors  
projecting therefrom, that directly interface with the first and second spaced  
apart conductive patterns, respectively; and

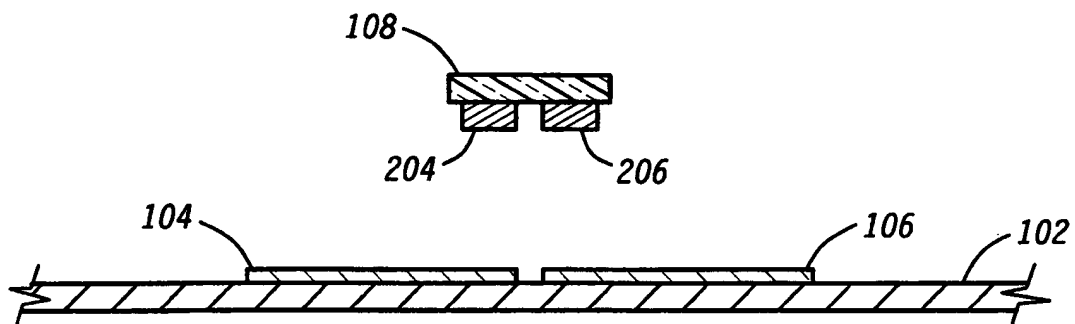
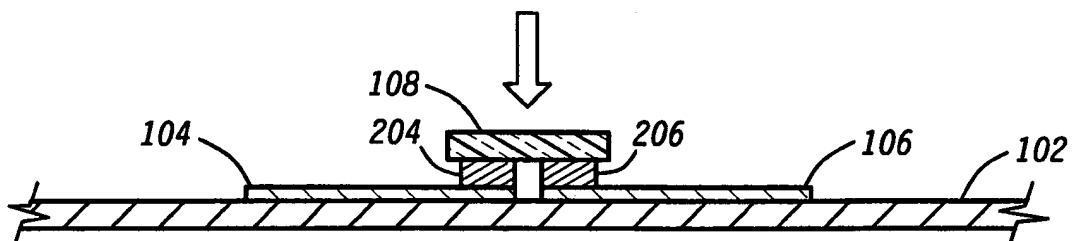
electrically non-conductive adhesive interposed around the first and second  
electrical interface conductors, and on the first and second spaced apart  
conductive patterns, which electrically non-conductive adhesive secures the  
integrated circuit die to the substrate.

10. The electronic tag of claim 9, wherein the substrate is formed from fibrous  
material, and conductive pattern comprises conductive ink disposed thereon.

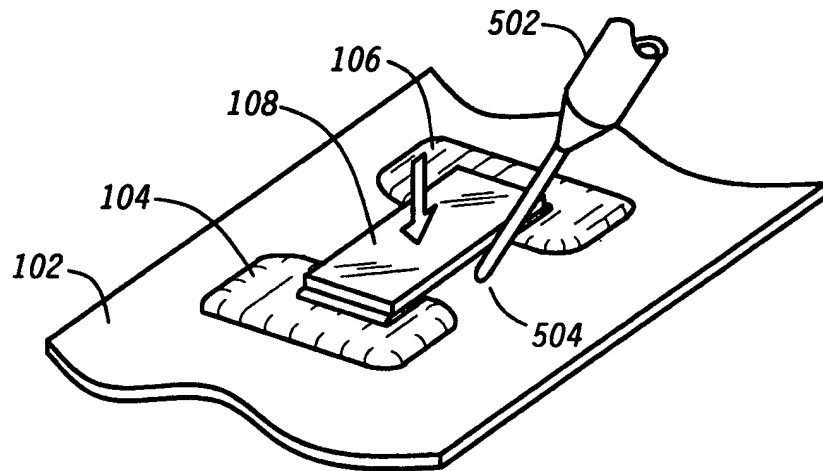
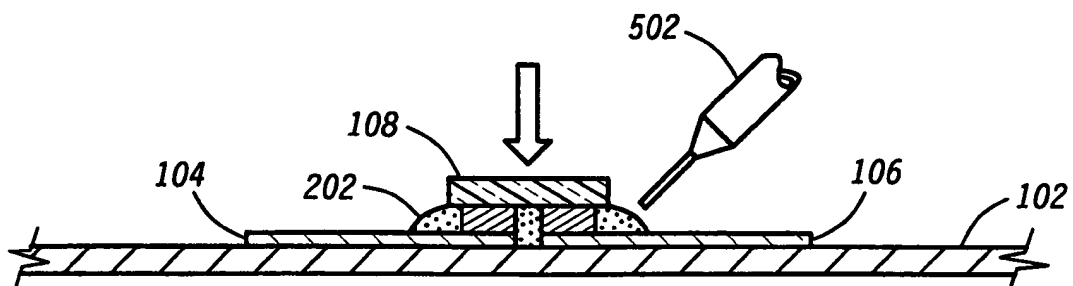
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**FIG. 1****FIG. 2**

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**FIG. 3****FIG. 4**

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**FIG. 5****FIG. 6**

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/US00/05522

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : C09J 5/00; G08B 13/14; H01L 23/52; B23P 19/00

US CL : 156/299,305; 340/572.7, 572.8; 257/782, 783; 29/740

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 156/299,305,295; 340/572.7, 572.8; 257/782, 783; 29/740,825,829,739,729; 343/789, 873, 906, 700MS

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y,P	US 6,018,299 A [EBERHARDT] 25 January 2000, col. 1, line 43 to col. 2, line 67.	1-10
Y,P	US 6,002,343 A [AUERBACH et al] 14 DECEMBER 1999, col. 3, lines 22-67.	1-10
Y,E	US 6,055,724 A [NISHINO et al] 02 MAY 2000, col. 1, line 10 to col. 2, line 25.	1-10
A	US 5,842,273 A [SCHAR] 01 DECEMBER 1998, col. 4, line 66 to col. 5, line 45.	1-10

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